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ABSTRACT

The "contextual hypothesis" of French and Brown (1977) concerning children's acquisition of temporal terms was tested. French and Brown claimed that it would be impossible for children to learn the meaning of temporal terms except by hearing them used in contexts where they referred to already known sequences, and further proposed that the terms would be understood in such contextually supported settings earlier than in settings where they established an order between inherently unordered events. Subjects were sixteen 3- and sixteen 4-year-old children. To assess subjects' understanding of the terms "before" and "after" 16 stories were composed that described activities with which young children could be assumed to be familiar. Half of the stories described activities having a more or less invariant real-world order. The remaining stories described activities that were familiar to young children, but that had no inherent real-world order constraints. The experimenter read each story and placed the picture corresponding to the sentence being read in front of the child. The order of the pictures corresponded to the order of events in the story. Following the presentation of each story the subject was asked what happened either before or after the third event. Results are discussed. (Author/RH)

Contextual Constraints on the Comprehension of Before and After

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In the past decade at least fifteen studies have addressed preschoolers' acquisition of before and after. Before and after, along with a few other relational terms, have the unique status of lying at the intersection of logic and language. Understanding how such relational terms are acquired will help us understand the relationship between logic and language and the way in which non-linguistic representations of causal and sequential knowledge are integrated with linguistic knowledge to produce descriptions of logical relationships.

A portion of the research on children's acquisition of temporal terms (Piaget 1927; Fraisse 1963; Cromer 1968, 1971; Ferreiro & Sinclair 1971) has been conceived and interpreted within the Piagetian framework, which holds that children's understanding of temporal terms is dependent upon particular abilities believed to underlie temporal representation. These abilities include reversibility, decentration, and an appreciation of sequentiality, and have been said by Piagetian theorists to be absent in the child until the onset of concrete operations at about age six or seven. Thus preschoolers would not be expected to form or to talk about temporal representations prior to this age.

However, contrary to this assumption of preschool incompetency, Ann Brown (Brown & French 1975, Brown & Murphy 1975, Brown 1976) has shown that preschoolers were indeed able to form sequences of events from sets of pictures, provided the sequences depicted logically ordered events. French & Nelson (1981) reported that even in the absence of pictoral prompts, preschoolers appropriately sequenced individual events when describing their

routine activities. Within this same data base, these researchers also found that preschoolers used the terms before and after appropriately, used the timeless verb form, an ability said to require decentration, and made temporal repairs, an ability said to require reversibility. It seems, then, that preschoolers are not as cognitively delayed in temporal understanding as a strict interpretation of Piagetian theory might suggest.

Apart from the attention prompted by Piagetian research, a high level of interest in before and after derived from Eve Clark's (1971) controversial claim that the acquisition of these terms could be accounted for by the semantic feature model. In testing preschoolers' comprehension of before and after, Clark required subjects to enact sentences formed by joining semantically unrelated clauses with these temporal terms. Within this paradigm, support for the semantic feature model depended upon all errors being reversals of the two events and upon comprehension of before preceding comprehension of after. While this patterning of the data was found by Clark, it was not found by subsequent investigators (Amidon & Carey 1972, Johnson 1975, French & Brown 1977, Coker 1977), suggesting that the semantic feature model may not be as valid an account of acquisition as it once appeared.

Most of the research that followed Clark's, however, addressed the adequacy of the semantic feature model without proposing alternative models of acquisition. The only alternative model of acquisition was proposed by French and Brown (1976). In accord with the theories of language development posited by Nelson (1974) and Macnamara (1972), they argued that a major flaw in the semantic feature model is that it overlooks the central role of extra-linguistic context in language acquisition. They claimed that it would be impossible for children to learn the meanings of temporal terms except by hearing them used in contexts where they referred to already-known sequences,

and further proposed that the terms would be understood in such contextually supported settings earlier than in settings where they established an order between inherently unordered events.

Two enactment studies based upon such reasoning (French & Brown, 1977; Kavanaugh, 1979) showed that preschoolers could enact semantically related event pairs conjoined by before and after earlier than they could enact semantically unrelated event pairs so conjoined (e.g., "Before Raggedy Ann feeds the baby, she fills the bottle" vs. "Before Raggedy Ann feeds the baby, the dog runs away"). However, interpretation of these data was problematic since it is possible that the subjects' greater success on logical sequences reflected a knowledge of the correct sequence of the paired events rather than comprehension of the temporal terms.

While recognizing this problem, we find a model of acquisition that places a major emphasis on context to be much more compelling than the relatively context-insensitive semantic feature model. The current study represents a direct test of the "contextual hypothesis" initially proposed by French and Brown (1977), using a comprehension measure that eliminates the problems of interpretation inherent in the enactment paradigm.

Method

The subjects were sixteen three- and sixteen four-year-old children. Sixteen stories were composed that described activities with which young children could be assumed to be familiar. Half of the stories (subsequently referred to as "invariant") were modeled on the results of Nelson's (1978, Nelson & Groundel 1981) investigations of preschoolers' event knowledge, and described activities having a more or less invariant real-world order. The remaining stories (subsequently referred to as "arbitrary") described activities that were familiar to young children, but that had no inherent

real-world order constraints. Each story contained six sentences. The first established a topic and the remaining five described activities related to the topic. Each story was illustrated by five individually mounted black and white drawings. Figure 1 shows examples of arbitrary and invariant stories and their illustrations.

Insert Figure 1 about here

The experimenter read each story and placed the picture corresponding to the sentence being read in front of the child. When the story was completed, the pictures were in a lineal array, with the order of the pictures corresponding to the order of events in the story.

Following the presentation of each story the subject was asked what happened either before or after the third (central) event. Unlike in the enactment paradigm, above chance discrimination depended upon comprehension of the temporal terms rather than upon a non-linguistic response strategy.

Results and Discussion

An age (two) by temporal term (two) by sequence-type (two) repeated measures ANOVA was carried out on the subjects' replies to the before/after questions. Across age and temporal term, the mean proportion of items answered correctly was significantly greater for the invariant (0.79) than for the arbitrary (0.64) sequences F (1, 30)=11.20, $p < .005$. There was also a main effect of age, with four-year-olds having a significantly higher proportion of correct answers (0.82) than three-year-olds (0.61) F (1, 30)=8.41, $p < .01$. There was also a significant interaction between age and sequence type F (1, 30)=4.47, $p < .05$. The mean proportion of correct responses by age and sequence type is shown in Table 1. T-tests indicated that the

performance of the three- and four-year-olds did not differ significantly on the invariant sequences but that the two groups were significantly different on the arbitrary sequences $t(30)=3.09$, $p < .01$. These results offer substantial support for the hypotheses that context influences the comprehension of temporal terms, and that the role of context diminishes with increasing age.

Insert Table 1 about here

Before/After Differences

Since a primary source of support for Clark's (1971) semantic feature account of the acquisition of *before* and *after* was her finding that children enacted *before*-sentences correctly at an earlier age than they enacted *after*-sentences, we looked at possible differences in performance as a function of temporal term. There was a main effect for temporal term; however, contrary to Clark's data, the present data showed a significantly better response to *after*- than to *before*- questions (mean proportion correct = .0.82 After, 0.60 Before, $F(1, 30)=12.21$, $p < .005$). In explanation of the contradictory findings, we suggest that the pattern of results found by Clark and that found in the present study may both reflect the use of non-linguistic response strategies. Therefore, neither finding can be interpreted as evidence for the earlier acquisition of one term.

Conclusions: What develops?

The data obtained in this study supported the initial hypotheses, namely that (1) comprehension of *before* and *after* is context sensitive, with the terms first being understood when they refer to invariant or knowable sequences, and only later being understood when they refer to variable or unknowable

sequences and (2) performance under these two conditions converges as a function of age. The description of the data indicates that they offer very little support for the semantic feature model of acquisition both because that account is insensitive to the contextual constraints which this study has shown to be operative and because, contrary to the semantic feature accounts, subjects in this study performed better on <u>after</u> than on <u>before</u> sequences.

We are now faced with the question of why context makes a difference in the comprehension of temporal terms and what it is that develops and leads to the developmental trend reported here. A pattern of success on the invariant sequences and failure on the arbitrary sequences indicates that the subjects understood the basic meaning of the temporal terms but were unable to respond appropriately to questions referring to the arbitrary sequences. In general terms, and with no claim of adequately describing internal mental processes, we propose that it is easier to form mental representations of invariant sequences, and that subjects who understand the meanings of the temporal terms can "read off" the appropriate answers to <u>before</u> and <u>after</u> questions from their mental representations of these sequences. These subjects must introduce an extra step, however, either memorizing or referring to and operating directly upon the pictured sequences, in order to respond appropriately to questions about the arbitrary sequences.

We posit that the difference in performance on the two types of sequence is, therefore, the result of a failure to produce or maintain an appropriate paradigm-specific response strategy, and believe that this is central to the issue of the full understanding of these terms.

The three-year-olds' above chance performance on the questions referring to the invariant sequences shows that the basic comprehension of

temporal terms occurs at a much earlier age than has previously been believed. That is, with a "fully supportive" context, children as young as three do reliably distinguish between before and after. However, as the context becomes less supportive, this basic comprehension of the terms is no longer, in and of itself, sufficient to support correct responses. In reply to the question "What develops?" we are proposing that it is not the basic understanding of before and after, but rather the ability to decontextualize the basic knowledge and thus to apply it more flexibly.

Our conclusion that what develops is the domain of application of basic understanding does not of course answer the logically prior and perhaps more interesting question of where basic understanding comes from. However, we believe that context-sensitive research and a context-oriented theoretical stance at least provide a more valid account of what the young child does know of the terms before and after and of the range of that knowledge than has previously been given. This marks a crucial step toward revising the current models of the acquisition of temporal terms.

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TABLE 1

Mean Proportion Correct Replies to Before and After Questions

Age	Sequence Type					
	Invariant			Arbitrary		
	Before	After	Before+After	Before	After	Before+After
3's	.61	.86	.73	.37	.61	.49	.61
4's	.75	.94	.84	.68	.89	.79	.81
			.78			.64	.71

Results of Age x Sequence type x Temporal terms ANOVA

Age: $F(1,30) = 8.41$, $p < .01$

Sequence type: $F(1,30) = 11.20$, $p < .005$

Temporal term: $F(1,30) = 12.21$, $p < .005$

Age x Sequence type: $F(1,30) = 4.47$, $p < .05$

ney got a shopping cart.

Then Jane sat in the little seat.

Her mother pushed the cart around the store and they put food in it.

Then they paid for the food.

Then they carried the groceries home.

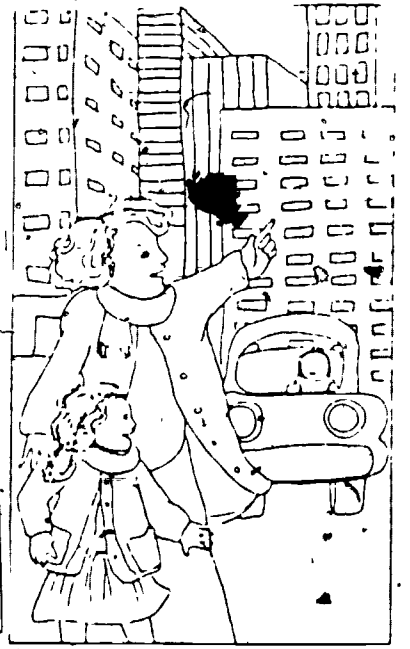
ARBITRARY: Jane's Aunt Sara came to visit one day...

They played with Jane's new doll

Then they colored in coloring books.

Jane's aunt made pan-pancakes and they ate them.

Then they sang songs.



Then they walked around outside.

FIGURE 1